

Selected Excerpts

Enbridge Gas Transmission & Midstream Alarm Management Plan 10/31/2018

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1 GENERAL

1.1 Scope

This Alarm Management Plan presents the high-level guidelines for alarm management at Enbridge. It includes an overview of the Alarm Management System and how Controllers respond to alarms, specifically referencing the Standard Operating Procedures where applicable. This document also describes the review processes that have been implemented to help ensure that the safety-related SCADA points and alarms are verifiably correct and support the Controller in safe operation of the pipeline.

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2 TERMS, DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

For the purpose of this document the following definitions apply:

Abnormal Operations (AO)

A condition or event on a pipeline system that exceeds design limits or results in a hazard(s) to persons, property, or the environment. Abnormal operations can be deviations from normal operations, when operational design limits of involved facilities have deviated from their acceptable parameters. Abnormal Operations may also be referred to as Abnormal Conditions or Abnormal Operating Conditions (AOC).

Abnormal Operation Limit

SCADA system alarm bit used to notify controllers when a critical pressure monitoring point min/max threshold has been breached. Also referred to as *AO Limit*.

Alarm

An audible or visible means of indicating to the controller, that equipment or processes are outside operator-defined, and/or safety-related parameters.

Alarm Flood

An alarm count greater than 6 per hour of Critical and/or Urgent priority is considered more than the controller can effectively manage.

Alarm Setpoint

Threshold value of an analog or discrete state or logic condition that triggers the alarm

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indication. Can also be referred as an alarm limit or alarm trip point.

Control Room

An operations center staffed by personnel 24/7/365 charged with the responsibility for remotely monitoring and controlling a pipeline facility through a SCADA system. Criteria used to determine which facilities meet this definition include: monitoring and controlling ability, and authority to take direct action beyond defined facility boundaries via the SCADA or local control system without direction from a Gas Controller. Enbridge's primary Control Room is located in **Houston, Texas** and the back-up Control Room is located in **Austin, Texas**.

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Emergency Operations

A condition or event that causes actual immediate risk of damage or injury to personnel, the public, property, equipment, or the environment. This is an unexpected situation that requires immediate attention (e.g. suspected leak, pipeline rupture, fire, explosion, etc.), or any other event determined to be an emergency condition by Gas Control Management. Emergency Operations may also be referred to as Emergency Conditions.

Field Personnel

Employees and contractors that are responsible for specific areas and/or pipeline facilities on-site and collaborating with Gas Controllers during normal, abnormal, and emergency situations.

Gas Controller

A qualified individual who remotely monitors and controls the safety-related operations of a pipeline facility via a SCADA system from a control room, and who has operational authority and accountability for the remote operational functions of the pipeline facility.¹

Gas Control Supervision

A Director, Advisor, Manager, Coordinator, or their designee charged with leading Control Room personnel and operations; synonymous with Gas Control Management. Gas Controller qualification status of Supervision will be communicated to Gas Controllers but these individuals are not required to be qualified as a Gas Controller.

Intermediate Pressure Monitoring Point

Enbridge requires that any pipeline segment exceeding 70 miles in length between compressor stations include an intermediate pressure monitoring point.

Normal Operations

Tasks and situations of a routine nature, such as control setpoint changes, performed during the process of monitoring and controlling the pipeline system to ensure safe, efficient, and reliable operations. Normal Operations may also be referred to as Normal Operating Conditions.

¹ Operators need to ensure that the definition of Controller is covered in their specific Roles & Responsibilities (Section 3).

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Principal Facility

A location that has been identified that 1) monitors or controls main line pipeline pressure, 2) main line valve site used for emergency response isolation, and/or 3) monitors main line H₂O or H₂S that house safety-related points. These locations will customarily include safety related points and alarms.

Operator

A person, or entity, that owns and/or is responsible for operating a pipeline facility. For the purposes of CRM-related documents, Enbridge (U.S.) Inc. ("Enbridge") is the Operator.

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Safety-Related

Any operation, SCADA point, alarm, piece of field equipment, task, etc., that could function to help operators mitigate a potential emergency condition.

Supervisory Control and Data Acquisition (SCADA) System

A computer-based system used by a controller in a control room that collects and displays information that collects and displays information about a pipeline facility and may have the ability to send commands back to the pipeline facility.

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2.2 Abbreviations

For the purposes of this document, the following abbreviations apply:

ACK	Acknowledgement of an alarm, alert or event
AMP	Alarm Management Plan
CFR	Code of Federal Regulations
CRM	Control Room Management
DI	Digital/discrete Input
DO	Digital/discrete Output
EI	Enumerated Input
ESD	Emergency Shutdown
HH	HI-HI or High High
KPI	Key Performance Indicator
LL	LO-LO or Low low
MADB	Master Alarm Database

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MOC	Management of Change
MOP	Maximum Operating Pressure
SOP	Standard Operating Procedures

3 ALARM APPLICATION AND DETERMINATION

3.1 Alarm Determination

In accordance with the Company's Alarm Philosophy, specific data points are configured to generate alarms in order to alert the Controller when pipeline systems deviate into the cautionary or critical zones as defined in Figure 1 of the Alarm Philosophy document. The severity level assigned to each alarm is determined by subject matter experts using an alarm rationalization process which considers various factors including but not limited to:

3.1.1 Potential loss of life or life threatening injury

Alarms that prevent harm to people and operational situations that deviate to a point that cause safety concerns are considered to be critical. This includes situations such as possible mainline rupture, failure of pressure regulation systems, exceeding mainline MOP, fires, and gas detection.

3.1.2 Damage to or loss of property and equipment

A number of situations can potentially result in damage to pipeline equipment. Alarm severity depends on the scale of potential damage and loss. (Some examples are: over pressure, facilities over temperature, and physical security issues). Alarm severity could be Urgent or Critical.

3.1.3 Environmental

Unintentional release of gas into the atmosphere.

3.1.4 Contractual Obligations / Regulatory / Gas Quality

When pressure, gas quality, or other transmitters deviate outside of contractual or regulatory agreements causing the customer to be impacted an alarm must be assigned. Alarm severities for these obligations are urgent.

3.1.5 Controlling and Monitoring the Pipeline

Data points that aid the Controller in performing their roles and responsibilities under various pipeline operating modes as defined in Section 2.2 and have an assigned alarm. Alarm severity depends on the potential impact to controlling and monitoring the pipeline. (Some examples are: approaching HiHi, unit and station recycle, communications failure, and gas quality, transmitter failure).

3.2 Purpose and Use of Alarm Priority

Enbridge Gas Control uses a SCADA-based Alarm Management System primarily to alert the Controller to abnormal operating conditions across the pipeline, by

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classifying operational alarms to 3 priority levels – Critical, Urgent and Warning. This is to ensure that the controller has clear guidance on what order to respond to the alarm.

Operational alerts and event notifications are also routed by the Alarm Management System to aware the controller of attention required or notify return to normal conditions.

Further details are specified the following sections:

3.2.1 Critical Priority 

The critical priority requires the controller's immediate action and are designated using the color red. This priority will also have an audible sound associated with the alarm.

3.2.2 Urgent Priority 

The urgent priority requires the controller's immediate response and are designated using the color .

3.2.3 Warning Priority 

The warning priority is assigned when the controller can timely resolve the alarm before the situation becomes worse. These alarms and are designated using the color .

3.2.4 Informational Priority 

The informational priority is used as operational or maintenance alerts to signal that attention is needed. The priority is indicated by using the color light blue.

3.2.5 Return to Normal Priority 

The Return to Normal priority (alarm clear) is used as an event to indicate that an alarm or alert point has returned to normal condition. The priority is displayed as the color green.

3.3 Safety-Related Alarms

This alarm category includes Personnel Injury Prevention alarms and Principle Mainline Pipeline Pressures that are used to monitor maximum and minimum abnormal operation limits- Maximum Operating Pressure (MOP) and possible rupture. These are designated below including but not limited to:

3.3.1 Alarms for Personnel Injury Prevention

- Station ESD
- Fire Detected
- Gas Detected
- Smoke, Fire or Gas Detector Failure
- Man Down
- H₂S Alarm
- Unexpected valve activity at mainline RCV Valve (Valve CLOSE and Valve OPEN status)

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3.3.2 Principle Pressure Monitoring Site

- Upstream and downstream pressures at compressor stations
- Intermediate pressure monitoring point²
- Mainline pressure regulation sites
- Upstream and downstream pressures at RCV sites
- Pressure monitored deferred MOP pipeline sections

3.4 Other Uses of the Alarm System

3.4.1 Maintenance Alerts for Field Personnel

The system also provides the ability to report on maintenance level information to Field personnel relating to the current status and serviceability of pipeline equipment. This maintenance information is included in pipeline system daily alarm reports.

4 ALARM DOCUMENTATION AND RATIONALIZATION

4.1 Rationalization Process

In adherence to the Alarm Philosophy, the Gas Control subject matter experts have applied the alarm priority for each type of alarm required in the SCADA system. Sections 4.3.1, 4.3.2, and 4.3.3 documents examples of the results of the alarm rationalization process. The SCADA alarm management system is configured to comply with the alarm priorities defined in this document.

4.2 Rationalization Methodology

Due to the large number of alarms in the SCADA system, the subject matter experts utilize the Alarm Rationalization application which aids them in reviewing large numbers of SCADA points to assure alarm severity consistency and identifies new SCADA system points that have not been rationalized.

The Alarm Rationalization application is a collection of defined rules combined with associated alarm behaviors that are specific to each point type. Gas Control subject matter experts have applied this relationship to all data points within the SCADA system. This application ensures alarming consistency within SCADA regarding the application of the Alarm Philosophy and the Alarm Management Plan that is imported to the tool.

4.3 Assignment of Alarm Priority³

4.3.1 Rationalized Critical Alarm States

Alarm rationalization for Critical priority (requiring immediate action) will include and but not limited to:

² Enbridge requires that any pipeline segment exceeding 70 miles in length between compressor stations include an intermediate pressure monitoring point

4.3.1.1 Alarms for Personnel Injury Prevention

- Station ESD
- Fire Detected
- Gas Detected
- Man Down
 - H2S Alarm

4.3.1.2 Principle Mainline Pressure Monitoring Sites

- Mainline compressor station inlet and outlet pressures
- Designated mainline intermediate pressure monitoring points
- Mainline pressure regulation sites
 - Mainline RCV upstream and downstream pressures
 - Mainline pressure monitored deferred MOP pipeline sections
 - Rate of change⁴

4.3.1.3 SCADA Communication Problem

- Poller Failure Alarm

4.3.1.4 Valve Monitoring

- Mainline valve normally closed
- Mainline valve normally open

4.3.2 Rationalized Urgent Alarm States

Alarm rationalization for Urgent priority (requiring immediate response) will include and but not limited to:

4.3.2.1 Control or Command Failure

- Compressor unit stop failure
- Compressor unit start failure
- Compressor valve open failure
- Compressor valve close failure
- Valve command failure
- Device control loop failure
- Fuse Alarm

4.3.2.2 Equipment Monitoring

- Building temperature alarm
- Boiler or heater alarms
- Call attendant alarm
- Control panel communication failure
- Pump or unit shut down alarm
- Fire and gas detector fail
- Instrument air systems alarms
- Power gas systems alarms
- Nitrogen pressure low
- Compressor unit unavailable
- Compressor unit unexpected shutdown
- Communication failure to Fire/Gas detection system

³ A full listing can be accessed through the Alarm Rationalization Tool

⁴ Rate of change alarming may be limited to specific pipeline systems and are classified as critical only under specific circumstances

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4.3.2.3 Gas Liquid Level Monitoring (High High Level)

- Tank Liquid Level
- Filter/Separator Liquid Level
- Scrubber Liquid Level
- Slug Catcher Liquid Level
- Sump Liquid Level

4.3.2.4 H2O Monitoring Points

- Hi H2O Alarms
- H2O level above tariff specification at flowing sites

4.3.2.5 Odorant System Monitoring

- Odorant injection system disruption
- Odorant tank level low
- Under pump alarm
- Odorant no flow alarm
- Pump alarm

4.3.2.6 Pressure Monitoring (Analog Points)

Urgent alarms are typically set on HH or LL with limits set accordingly.

- Contract pressure where indicated
- Line pressures at meter sites when present
- Receipt or delivery pressure at select sites

4.3.2.7 Security Alarms

- Intrusion Alarms

4.3.2.8 Temperature Alarms

- Temperature at meter station with heated gas

4.3.2.9 Valve Monitoring

- Mainline valve in unexpected travel status
- Station valve normally closed
- Station valve normally open
- Mainline pressure monitor valve closed
- Mainline pressure monitor valve in travel

4.3.3 Rationalized Warning Alarm States

Alarm rationalization for Warning priority (timely response) will include and but not limited to:

4.3.3.1 Battery and Power System Alarms

- AC or DC Power Fail
- Battery Charger Alarms
- Inverter Fail
- Power Generator Alarms
- UPS Fail
- Voltage (Low or High)

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4.3.3.2 General Compressor Station and Unit Alarms

- No Gas Path
- Valves Out of Position
- Meter Station Valve Position Alarms
- Compressor Station Valve Position Alarms
- Tank level high alarm
- Station or unit recycle alarm
- Unit vibration alarm
- Input failure alarm

4.3.3.3 Gas Liquid Level Monitoring (High Level)

- Tank Liquid Level High
- Liquid System Alarm
- Scrubber Alarm
- Sump Alarm

4.3.4 Communication Failure Alarms

Communication alarms have been categorized into three levels of outage time based upon the facility and equipment located at the site.

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6 ALARM HANDLING OVERVIEW

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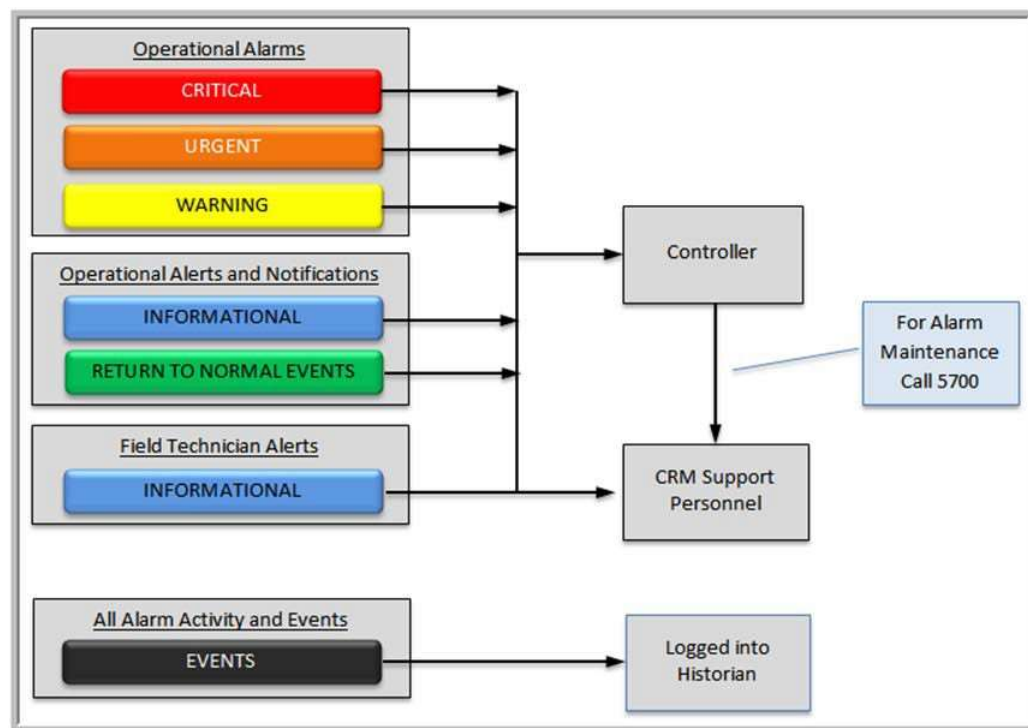


Diagram 1: Alarm Management System Overview depicts the alarms, notifications and events that are routed by the Alarm Management System, and who has the responsibility to handle them.

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6.2 Alarm Routing

The alarms defined in sections 4.3.1, 4.3.2, and 4.3.3 are a representative list of the alarms that are routed to a Controller, since these alarms require Controller action. All return to normal notifications and normal state events are also routed to a Controller in order to provide them with information on the updated status.

Equipment and process failure alarms may require the Controller to notify Field Personnel for resolution. The initial 24 hours of maintenance activity is tracked by the Controller, beyond 24 hours the alarm(s) will be suppressed and transferred to CRM Support, to work with field until its resolution. (See Diagram 4: Change Management for Safety-Related Alarms Maintenance, pg. 26)

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6.4 Alarm Audit and Enforcement

Enbridge has developed an alarm enforcement application called AlarmRationalization tool (AR). See previous section 4.2 for further detail.

To ensure consistent enforcement of the rules defined in the Alarm Rationalization application, a Gas Control Supervision frequently reviews the application, identifies points that are mismatched by comparing SCADA configured alarms and the Alarm Rationalization rules, and resolves those items. Gas Control Supervision also performs periodic rationalization on new points and reviews Alarm Rationalization rules.

Additionally the report, SCADA vs Alarm Rationalization Comparison Report, is distributed daily to Gas Control Supervision to monitor critical priority safety related point alarm mismatches between SCADA system and AR database.

6.5 Special-purpose Priorities and Alarm Routing

6.5.1 Field Personnel Alerts

The alarm management system was designed to utilize a specific priority range for Field Personnel maintenance alerts. These alerts are included in the Pipeline System Alarm reports. Typically these types of alerts are filtered out of the Gas Controllers alarm panel but may be selected to be displayed if the controller chooses.

6.6 Alarm Activity Reports

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6.6.4 SCADA vs Alarm Rationalization Comparison Report

The SCADA vs Alarm Rationalization Comparison report was developed to monitor critical priority safety related point alarm mismatches between SCADA system and AR database. The report is distributed daily to Gas Control Supervision and used frequently to initiate corrections or changes to AR tool or safety related points.

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7 ALARM AUDITS AND PERFORMANCE MONITORING

7.1 Alarm System Performance Metrics

To insure optimal tuning of alarm configurations and operations, periodic analysis measuring alarm activity shall be performed at a minimum of quarterly intervals. The results of these analyses will capture comparative data and current alarm frequency load against the Engineering Equipment and Materials Users Association (EEMUA) Industry Standards benchmarks.

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7.2.1 Monthly Safety-Related Shelved Alarm Review (192.631(e)(1-3))¹⁰

The CRM support team produces a monthly status report, Safety Related Shelved Alarm Report, containing safety-related alarms and points that have been made inoperative; such as suppressed, manually overridden, disabled, taken off scan, or alarm limits set such that the alarm would not trigger under expected conditions.

This monthly report Safety Related Shelved Alarm Report is sent to Gas Control Supervision or designee.

This status report is archived as an operational record by CRM Support and is retained according to the Enbridge document retention policy for reviews/audits.

With respect to inoperative alarms and points, the following responsibilities are defined:

- CRM support is responsible for following up with the Field to ensure that the maintenance work has been completed, verifying the status of the affected alarms, then returning them to an operational state, adhering to proper change management procedures.
- The Field is responsible for performing the maintenance actions and notifying CRM support when the work has been completed so that the affected alarms may be returned to an operational state.
- Gas Control supervision is responsible for identifying any operational changes that may be necessary due to the deactivated alarms and communicating those changes to the Controllers

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7.2.1 Annual Safety-Related Alarm Review (192.631(e)(1))¹¹

The annual safety-related alarm review is an inventory and configuration verification on all safety-related data points in the SCADA System that has been assigned "Critical" priority. The Safety Related Points Database Tool (Baseline) is used for ongoing maintenance of safety related data points.

¹⁰ Cross Reference CRM Plan Section 6.2

¹¹ Cross Reference CRM Plan Section 6.1

Gas Control Supervision is responsible for performing the bulk analysis of these safety-related alarms/ points and CRM Support staff produces an annual report called “Baseline Report” for approval.

The Safety-Related Points Database Tool is organized by facility and contains the following information for every safety-related alarm:

- Alarm description
- Indicator showing whether the alarm is operative or inoperative (see section 8.2.1)
- For analog values; alarm settings for LoLo, Lo, Hi, HiHi configured values
- For discrete values; state for alarm and the corresponding text
- Indicator showing whether the alarm agreed with its baseline configuration
- Reason for the discrepancy from baseline (if known)
- Proposed changes to bring alarm back to baseline

The alarm review report will be distributed to Gas Control Supervision, which may order specific alarm discrepancies to be resolved and must follow the change management process to make the required changes to the SCADA system. This alarm review report is archived as an operational record by CRM Support and is retained according to the Enbridge document retention policy for reviews/audits.

7.2.2 Alarm Management Effectiveness Review (192.631(e)(4-6))¹²

A review of this document may be performed anytime the Director of Gas Control deems necessary but is required to occur at least once per calendar year, not to exceed 15 months.

The review takes the form of a meeting involving selected Gas Control and CRM support personnel with the objective of gaining a cross-functional perspective. The meeting reviews uncommon or significant operational experiences since the last review of the Alarm Management Plan (AMP) and determines whether or not the AMP and associated Standard Operating Procedures (SOP) optimally addressed these situations. The review also includes analysis of the alarm management system effectiveness through a series of reports that are generated by CRM support. These reports are distributed to the attendees at least 14 days prior to the meeting so that they have an opportunity to perform any required analysis.

The review includes, but is not limited to the following:

¹² Cross References CRM Plan Sections 6.3 & 6.5

- Alarm Baseline Configuration (see section 4.1.3)
- Safety-Related Shelved Alarms (see section 4.1.2)
- Management of change adherence (see section 5.1)
- Performance Analysis to help determine the effectiveness of the AMP (see section 4.1.4)

The findings from the meeting are included in a meeting report that identifies the main discussion points, decisions made, and actions assigned. The actions should be tracked at the monthly alarm review.

If any deficiencies are found in the AMP and/or SOP's, then a specific proposal to update the AMP and/or SOP's is authored and requires approval by the Director of Gas Control prior to implementation.

The AMP review findings report is subject to Enbridge's document retention policy for reviews/audits.

7.2.3 Change Management (192.631(e)(1,4,6))¹³

Enbridge uses a change management system for document control and for safety-related alarms. All/any alarm change request shall be approved by a Gas Control Supervision before changes are made to the SCADA system (see SOP 13-5010). The records in the change management system are retained according to the Enbridge's document retention schedule by the SCADA Support group.

7.2.3.1 Change Management of Safety-Related Alarms (192.631(e)(1))¹⁴

All support/maintenance actions which involve safety-related alarms and points, utilize a ticketing system to track actions to completion. The general workflow of these support/maintenance actions is shown in the following flow chart:

¹³ Cross Reference CRM Plan Sections 6.1, 6.3, & 6.5

¹⁴ Cross Reference CRM Plan Section 6.1

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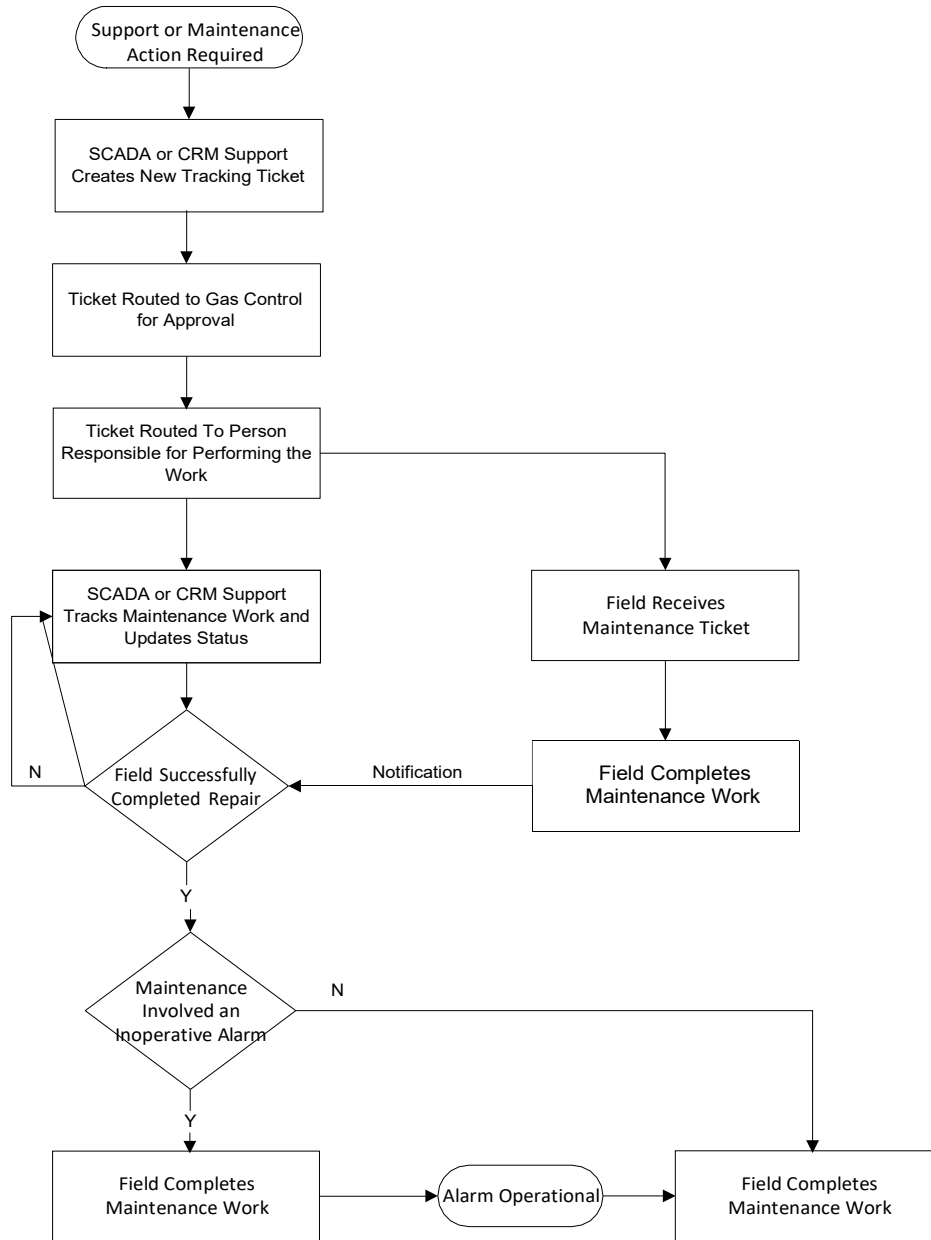


Diagram 4 – Change Management for Safety-Related Alarm Maintenance Flowchart

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APPENDIX B –ALARM ACTION TABLE

Color	Priority	Class	Action	Comments
Red	99	Critical AO Limit	Immediate action required. Create AO report and notify supervisor. Log alarm and associated event activity in to the Gas Control Daily Event Log.	Pressure has exceeded MOP or is below 25% of MOP at a designated monitoring facility
Red	98	Critical Safety	Immediate action required. Controller is required to notify field operations representative and system operations personnel. Log alarm and associated event activity in to the Gas Control Daily Event Log.	Fire and gas detection system, ESD and Man Down alarms. Mainline RCV position in abnormal Open or Close state. High H2S at facility
Orange	74	Urgent Operational	Immediate response required. Controller is required to notify field operations representative. Log alarm and associated event activity in to the Gas Control Daily Event Log.	Operational alarms at facility. Examples of this priority include but are not limited to: Call Attendant, abnormal pressures, control failures, tank or filter separator HH levels, Intrusion/Illegal Entry, etc. Depending on the nature of the alarm, the controller might consider taking specific action to prevent the alarm condition from becoming "Critical".
Orange	73	Urgent Contract	Immediate response required. Controller is required to notify field operations representative and system operations personnel. Log alarm and associated event activity in to the Gas Control Daily Event Log.	Contract pressure violation at meter facility.
Orange	66	Urgent Gas Quality	Immediate response required. Controller is required to notify field operations representative. Log alarm and associated event activity in to the Gas Control Daily Event Log.	High H2O at facility.
Orange	60	Urgent Communication	Immediate response required. Communication outage at facility. After SCADA verification of outage, the controller may be instructed to report the outage to field operations representative and document the action with a note in the Gas Control Daily Event Log.	Class 1 - Consists of remote devices containing compressor stations, RCV sites, pressure monitoring sites and regulator stations. Alarms after 1 hour of continuous communication outage. Class 2 - Consists of remote devices containing controls, gas chromatographs or moisture analyzers. Alarms after 3 hours continuous communication outage. Class 3 - Consist of remote devices containing single run non-controlled meters. Alarms after 6-24 hours of continuous communication outage.
Yellow	49	Warning Operational	Timely attention required. Controller is required to be attentive to alarm to ensure condition does not deteriorate and may need to report to field operations representative. Actions may include changing horsepower, regulator pressure, etc.	Operational alarms at facility. These alarms are assigned when the controller can timely resolve the alarm before the situation becomes worse. <u>Note for All Warning Class Alarms:</u> <i>If the controller opts, as an action for alarm resolution, NOT to notify the field technician, the controller takes ownership and responsibility to monitor and resolve.</i>
Yellow	40	Warning Communication	Timely attention required. Communication outage at facility. After SCADA verification of outage, the controller may be instructed to report the outage to field operations representative and document the action with a note in the Gas Control Daily Event Log.	See Urgent communication category above.
Yellow	27	Warning I/O Failure	Timely attention required. Instrumentation failure on a device at facility. Controller may need to report to field operations representative.	Instrumentation failure on a device is typically indicated by a negative number on analog point (AI) or "Trouble" state on an enumerated point (EI) such as a valve status.
Blue	15	Information	No action required by controller.	For notification only.
Blue	11	Information Report Only	No action required by controller. Information class alarms are included in "The Alarm Count Report" and "Active Alarm Report". These are used to convey the low priority alarms to field operations representatives.	Daily activities of all alarms are reported on these reports. These are useful tools for field operations representatives to troubleshoot or diagnose problem locations.

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APPENDIX C –SETTING DELAYS FOR ALARM TUNING

To improve accuracy of received alarm states from the field and reduce chattering instances, delays in alarm reporting have been configured. Below table shows all the point categories with associated alarm limits and the configured alarm report delay for each limit. Note the delay is in seconds.

UDC	Description	Delay (s)	Alarm Limit
...			
PRDN	Down Stream Press	300	Low Out of Range
PRIN	Inlet Pressure	300	Low Out of Range
PROUT	Outlet Pressure	300	Low Out of Range
PRSTAT	Static Pressure	300	Low Out of Range
PRUP	Up Stream Press	300	Low Out of Range
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